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Newfoundland & Labrador Region
Canadian Science Advisory Secretariat
Science Advisory Report 2010/021

RECOVERY POTENTIAL ASSESSMENT FOR ROUNDNOSE GRENADIER (*CORYPHAENOIDES RUPESTRIS*)

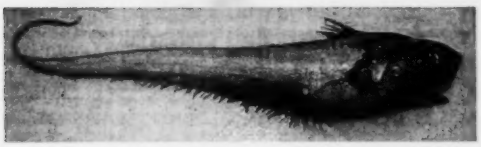

Photo by C. Nozeres

Figure 1: Roundnose Grenadier global distribution (Aquamaps Computer generated distribution map, http://www.aquamaps.org)

Context :

In 2008 the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), assessed Roundnose Grenadier (Coryphaenoides rupestris) in the Northwest Atlantic as Endangered based on declines in the Fisheries and Oceans Canada (DFO) research vessel (RV) surveys. The Minister of the Environment forwarded the assessment to the Governor in Council in 2009. Based on recommendations from the Minister of the Environment, in consultation with the Minister of Fisheries and Oceans, the Governor in Council proposed listing decision will be published in Canada Gazette I. Public comments will be accepted after which the Governor in Council will then make a final listing decision which will be published in the Canada Gazette II. The Decision can be to accept the COSEWIC assessment and list the Roundnose Grenadier, decide not to list the species, or send the species assessment back to COSEWIC for further information or consideration. If the recommendation is to list the Roundnose Grenadier as endangered, a Recovery Strategy will be required within one year. If it should be listed as threatened (or extirpated), a Recovery Strategy will be required within two years.

The general intent of this document is to provide the scientific advice required for development of a Recovery Strategy should it be deemed necessary. Most of the material in the document is derived from DFO Research Vessel surveys to complete the Recovery Potential Assessment that was reviewed on February 11 2010. The specific intent of this document is to provide information and advice on current status and trends, to assess the impact of human activities on the species, to identify possible alternatives and management measures to mitigate these impacts, and to assess the potential for recovery.

Canada

SUMMARY

- Roundnose Grenadier *(Coryphaenoides rupestris)* was designated as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2008.
- Roundnose Grenadier are long-lived, slow-growing and late to mature, and therefore have long population turnover rates. Estimated generation time is 17 years.
- Roundnose Grenadier is under moratorium within the Canadian Exclusive Economic Zone (EEZ) of the North Atlantic Fisheries Organization (NAFO) Subareas 0, 2 and 3. However, *C. rupestris* is still captured as by-catch in other commercial fisheries inside and outside Canadian waters. Outside Canadian waters, the Roundnose Grenadier catches are unregulated with the exception of mesh size in other fisheries.
- Available abundance indicators from RV surveys are limited and sample only a portion of the preferred depth range/distribution of this species.
- Although it has been recorded that the population declined since the beginning of the commercial fishery in 1967, recent RV survey data indicate that population levels appear to be relatively stable since the early 2000s.
- Population models indicate that current bycatch levels appear to be sustainable; however reduction in bycatch could enhance recovery of *C. rupestris*.

BACKGROUND

Rationale for Assessment

In 2008, Roundnose Grenadier was designated as Endangered by COSEWIC, based on declines both in the Fisheries and Oceans Canada (DFO) fall research vessel bottom trawl survey in NAFO Divisions 2J3KL and in commercial catch rates. Roundnose Grenadier also has life history traits, such as late maturity and being long lived, which can contribute to this species being unable to respond quickly to reductions in population size.

Under the Species at Risk Act (SARA), there are three major goals:

- To prevent wildlife species from becoming extinct or extirpated;
- To provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activities; and
- To manage species of special concern to prevent them from becoming endangered or threatened.

DFO has established an evaluation framework to assist in making decisions on listing of potential SARA species, permitting incidental harm of listed species and in support of recovery planning. This framework consists of three phases: assessment of current/recent species status, determination of the scope for management to facilitate recovery and scenarios for mitigation and alternatives to activities. The purpose of this paper is to provide the required information to inform decisions relating to the possible listing of Roundnose Grenadier on Schedule 1 of SARA.

Description of Designatable Unit

In the absence of any information to suggest local adaptation and genetic differentiation within the western North Atlantic, the working hypothesis as defined by COSEWIC (COSEWIC 2008)

is that Roundnose Grenadier comprise a single designatable unit *in the waters off Atlantic Canada, including the deeper waters beyond the 200 mile limit.*

Species Biology and Ecology

Roundnose Grenadier are found in the Northwest Atlantic along the continental slope from Cape Hatteras north to Baffin Island and Greenland (figure 1) as well as in the Northeast Atlantic. A deepwater species, they are found at depths of 180m – 2600m but primarily occur between 400m -1200m. Roundnose Grenadier undergo diurnal vertical migrations that can move them more than 1,000 m off the bottom and may also seasonally move up and down the Continental Slope. They are known to undertake vertical migrations to feed on a variety of small crustaceans, squid, and small fish. Based on catch rates off northeast Newfoundland and Labrador, they appear to move into deeper water in winter, and shallower water towards the end of summer; possibly in pursuit of prey, or in relation to water temperature.

This species is distinguished from other North Atlantic grenadiers by its relatively short, compressed head and soft-rounded nose with a small, button-shaped scute at its tip. In the Northwest Atlantic, Roundnose Grenadier are associated with a temperature range of 3.5–4.5°C, and form dense concentrations where warm water lies directly above the bottom. This species also appears to prefer areas of weak or absent currents, and form dense concentrations in troughs, gorges, terraces, and lower parts of the slope. Larger fish are usually found further north, and in deeper water.

Fecundity in Roundnose Grenadier is determinate and relatively low: females produce 8,700-56,000 eggs. They breed more than once in their lifetime (iteroparous) and release eggs in more than one spawning event during each spawning season (i.e. "batch" spawners). However, timing of peak spawning is unknown. The majority of fish in the Rockall Trough, northwest of Scotland and Ireland, were spent or recovering in April and ripe in September. In contrast, some researchers believe spawning occurs from May through September, or even throughout the year.

Length at which 50% of the population is mature has been reported to be 48 cm for males and 57 cm for females. This corresponds to an approximate age of 10 years in females. The age at which all females appear to be mature is 16-17 years. Although exact lengths at maturity are debated, it is generally agreed that Roundnose Grenadier will begin to mature at 40-50 cm total length.

Roundnose Grenadier are long-lived, slow-growing, and late to mature. Age interpretations based on otoliths indicate individuals of 90-100 cm total length are 40 years old with longevity estimated up to 60 years. Females are larger and heavier than males. Since estimated generation time is 17 years, this species is typically recruited to fisheries before becoming fully mature.

Most estimates of natural mortality in Roundnose Grenadier have been reported to be at the higher end of the range between 0.1 and 0.2. However, longevity estimates would indicate that natural mortality is likely nearer the lower end of this range.

ASSESSMENT

Roundnose Grenadier in the Northwest Atlantic are found in deepwater off the continental shelf (180m – 2600m). This Recovery Potential Assessment (RPA) is based on Fall RV bottom trawl surveys which sample only a limited portion (<1500m) of the species' inferred range (to 2600m). Therefore, it is uncertain to what extent the survey data reflect trends in population abundance.

Historic and Current Abundance and Trends

As noted, indices of abundance based on Fall DFO-NL bottom trawl RV surveys are available only from a limited area of the species distribution in NAFO Division 2J3KLNO. The longest time series with the deepest coverage is in NAFO Division 2J3K (Fig. 2). Bottom trawl surveys conducted with an Engel trawl show a decline from the late 1970's to 1994. Subsequently, the survey indices from 1995 to present conducted with a Campelen trawl have fluctuated without a strong trend. The Engel and Campelen time series are not comparable as one series due to different gear and fishing protocols deployed.

While the observed historical decline in abundance indices from bottom trawl surveys could reflect a potentially real decline in abundance, the surveys do not sample the total population, nor do they sample the entire depth distribution of Roundnose Grenadier. However, given these caveats and uncertainty in the estimated decline rates, they are still considered as plausible.

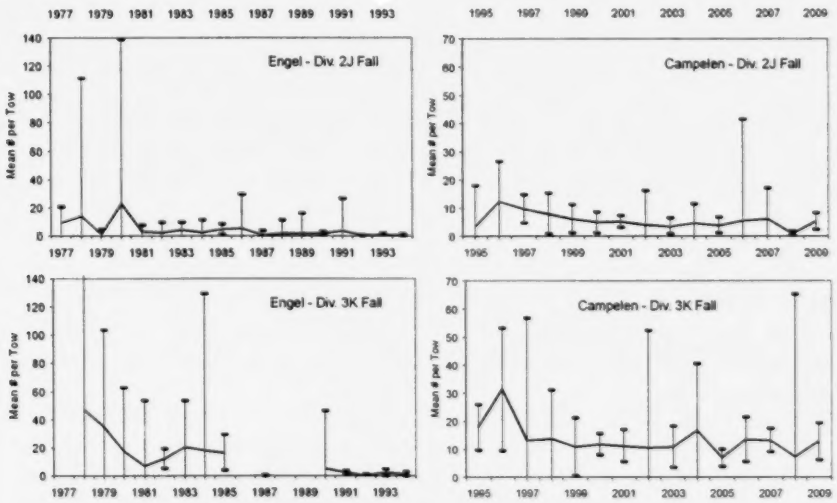

Figure 2. Mean numbers per tow of Roundnose Grenadier from Canadian fall research surveys of all strata in NAFO Divisions 2J3K, 1977-2009. Engel and Campelen time series are not comparable as one series due to different gear and fishing protocols deployed. Vertical bars represent 95% confidence intervals.

Estimates of the abundance of juvenile (< 10 cm pre-anal fin length - PAL) and adult Roundnose Grenadier from Canadian fall surveys in Div. 2J3K indicate significantly decreasing trends in the Engels time series for both juvenile and adults. Trends in abundance in the Campelen surveys (1995-2009) indicated a stable abundance over the past decade at low levels for adult, while juveniles appeared to fluctuate or decline over the past decade (Figure 3).

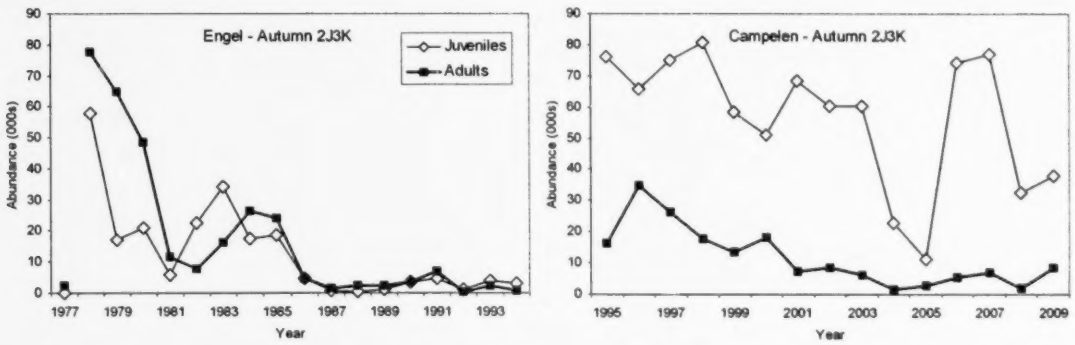

Figure 3: Estimated numbers of juvenile and adult Roundnose Grenadiers (STRAP1 abundance-at-length; juveniles < 10 cm PAL) from Canadian fall research surveys of Div. 2J3K, 1977-2009. Engel and Campelen time series are not comparable as one series due to different gear and fishing protocols deployed. All strata were included in estimates.

Population Trajectory Under Varying Conditions

Population dynamics of Roundnose Grenadier were modeled using a Bayesian state-space implementation of the Schaefer Surplus Production (SP) model for NAFO Subareas 2+3. The model incorporates total catch (directed + bycatch); an index of stock biomass estimated from Canadian research vessel autumn surveys in NAFO 2J3K; and separate CPUE indices based on NAFO, and Canadian Fisheries Observer data.

In the models forecast to 2028 (20 years forward), estimated bycatch rates set from 0.0-1.0 kt·year^{-1} all showed increases in biomass over time, with no indications of decline. At an estimated bycatch rate of 1.25 kt·year^{-1}, biomass was maintained at a consistently low level throughout the 20-year projection giving no indication of an increase or a decline. The rate of population decline increased at an estimated bycatch rate of 1.5 kt·year^{-1} and, at 3.0 kt·year^{-1}, the projected decline was relatively rapid (Figure 4).

It should be noted that 95% credible intervals increase dramatically as the model approaches forward projections of 20 years, and thus these simulations should be accepted as guidelines only.

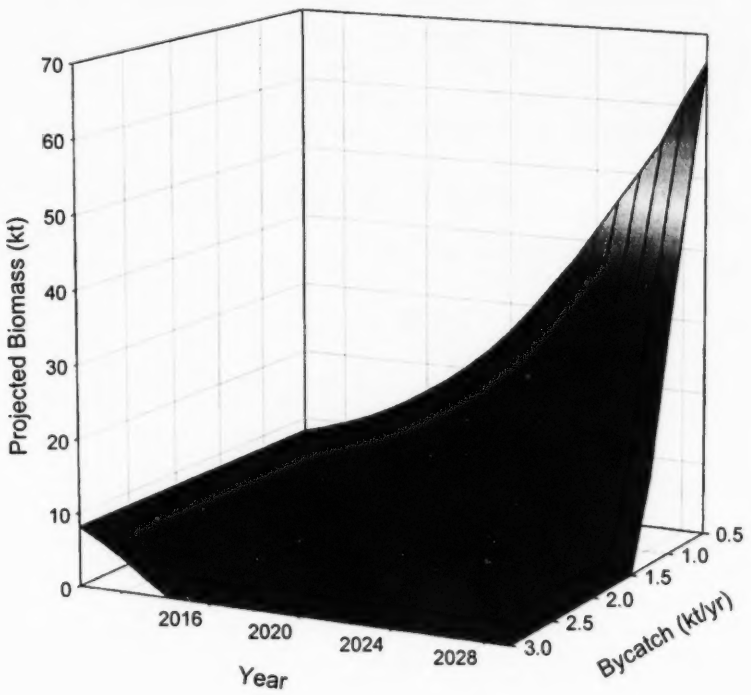

Figure 4: Biomass projections for all simulations of biomass based on various bycatch levels.

Historic and Current Distribution and Trends

Roundnose Grenadier are caught in the Davis Strait, along the continental slope off of Newfoundland and Labrador, along the edge of the Grand Banks, Georges Bank, and Flemish Cap. The survey distribution show catches are concentrated along the perimeter of the continental slope in Div. 2HJ3KLNO (figure 5). For Div. 3LNO most of this occurs outside the 200-mile limit.

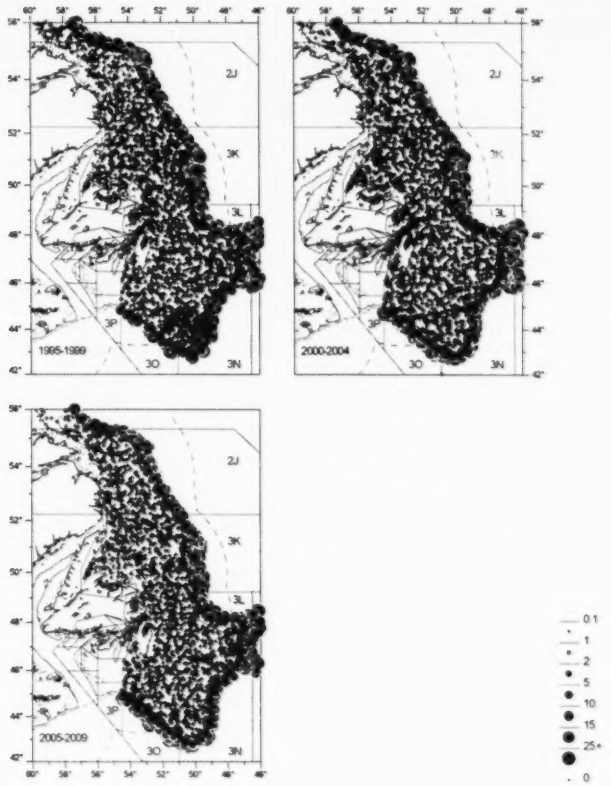

Figure 5: Distribution of Roundnose Grenadier in DFO-NL Fall RV surveys during 1995-1999 (Top-left), 2000-2004 (Top-right) and 2005-2009 (Bottom-left).

The Designated Weighted Area Occupied (DWAO) index of distribution is based on the RV surveys that cover only a limited portion (<1500m) of the range of Roundnose Grenadier in the Northwest Atlantic (to 2600m). The DWAO index has fluctuated without trend using a consistently sampled subset of strata in NAFO division 2J. A similar pattern is evident in NAFO division 3K with the exception of the initial two years of the series. Overall, it appears that there has been no reduction in the range of Roundnose Grenadier within the survey area (figures 5 and 6).

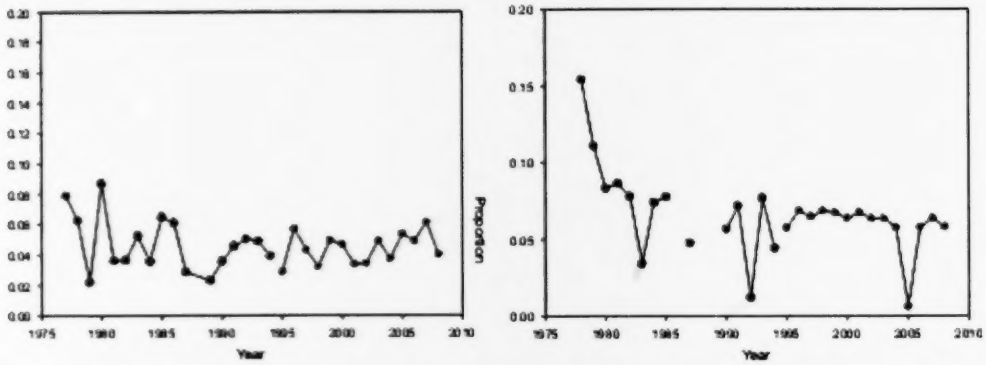

Figure 6: Proportion of area occupied by Roundnose Grenadier for Canadian autumn research surveys in Div. 2J (left panel) and 3K (right panel). Note that trawl gear changed from Engel to Campelen in fall 1995.

Information to Support Identification of Critical Habitat

As a deepwater benthopelagic species there is a lack of information related to critical habitat for this species. Data on the physical, structural or biological aspects of the habitat are currently not collected at the appropriate scale to define critical habitat. Furthermore, given the lack of knowledge on biological processes for this species, such as spawning, geographic areas which may be essential habitat for life processes are unknown to at this time.

Residence

Roundnose Grenadier are benthopelagic to bathypelagic at depths from 180m to 2600m. Generally this species is associated with temperatures that are 3.5-4.5°C.

Roundnose Grenadier do not have any known dwelling-place similar to a den or nest during any part of their life.

Recovery Targets

The *Species at Risk Act* does not define recovery, but expert groups must reach consensus on biological characteristics of a population which would constitute "recovery" as a core part of science support to recovery planning. This has sometimes been difficult. A framework for developing science advice on recovery targets (CSAS 2005/054) reviewed 16 biological attributes with regards to their usefulness as components of recovery descriptions and recovery plans. Direct measures of Abundance and Total Range Occupied emerged as the preferred biological traits to use in specifying recovery targets and focusing recovery efforts.

In the description of recovery it would be reasonable to consider an abundance goal in the context of the historical population size, a population growth rate or level of surplus production, an age composition, and an abundance-weighted description of range.

Abundance

Reliable estimates for the historical or current absolute abundance of Roundnose Grenadier are lacking. In addition, all available abundance indicators sample only a portion of the preferred

depth range/distribution of this species. Given these uncertainties, and considering the best available information for this species, a recovery goal for Roundnose Grenadier would be a sustained increasing trajectory in the current abundance indices.

Distribution

Given the lack of change in the distribution of this species, a distributional recovery goal for Roundnose Grenadier would be to maintain the current area occupied.

Threats to Survival and Recovery

Fishing is the only known source of human-induced mortality on Roundnose Grenadier which can be estimated and managed. Total Allowable Catches (TACs) were set for the *C. rupestris* fishery in 1974. NAFO catch data (1960-2008; from the Northwest Atlantic Fisheries Organization) for all areas indicate that reported catches of Roundnose Grenadier averaged 30,000-31,000 tons during the 1960s and 1970s; with a peak of 56,998 tons for subarea 2 in 1971. Reported catches rapidly declined during the 1980s to an annual average of 5,400 tons. During the 1990s, reported catches declined further to an average of 1,600 tons. For the period 2001-2006, NAFO-reported catches increased to an average of 3,475 tons; albeit catches for 2007-2008 averaged 373 tons.

Currently, there is a moratorium on this fishery in NAFO Subarea 0, and Canadian waters of Subareas 2 and 3. However, Roundnose Grenadier is still caught as bycatch in other fisheries; primarily in the Greenland Halibut fishery both inside and outside of Canada's EEZ. Roundnose Grenadier was also captured historically in Witch Flounder fisheries in 3KL and in American Plaice fisheries in 3N, both of which are currently under moratorium. Fisheries outside Canada's EEZ also have the potential to directly impact the survival and recovery of this species.

Model projections based upon the Bayesian surplus production model indicate that bycatch at current levels would not impede the rebuilding plan for Roundnose Grenadier. However, bycatch exceeding 1.25kt would have a negative influence on Roundnose Grenadier recovery.

There may also be possible direct and indirect threats to the survival and recovery of Roundnose Grenadier as a result of environmental changes (e.g., shifts in temperature regimes).However, the impact is currently unknown.

Limiting Factors for Population Recovery

Roundnose Grenadier are long-lived, slow-growing, and late to mature. Fecundity is estimated to be relatively low and estimated generation time is 17 years. As a result, the life history characteristics of Roundnose Grenadier may be a limiting factor to the recovery of this species.

Because of the estimated generation time of 17 years, this species is often recruited to fisheries before becoming fully mature. Although Roundnose Grenadier is under moratorium within the Canadian EEZ of NAFO Subareas 0, 2 and 3, *C. rupestris* is still captured as by-catch in other commercial fisheries inside and outside Canadian waters. Outside Canadian waters, the Roundnose Grenadier catches are unregulated with the exception of mesh size in other fisheries. Therefore, fishing mortality, including that which occurs outside of Canada's EEZ may be a limiting factor for population recovery.

Mitigation and Alternatives

A number of measures have already been put in place to mitigate threats to existing populations of Roundnose Grenadier. These measures include changes in fisheries regulations that make directed fishing for the species illegal in Canadian waters. However, Roundnose Grenadier are still captured as by-catch in other commercial fisheries inside and outside Canadian waters, and outside Canadian waters, Roundnose Grenadier catches are unregulated with the exception of mesh size in other fisheries. Therefore, continued monitoring of by-catch rates both in Canadian waters and outside Canada's EEZ to ensure that fishing mortality does not increase is essential.

Though there is currently no directed fishery for Roundnose Grenadier outside the 200 mile limit, there is no moratorium in place. Therefore, any future commercial fishing outside the 200 mile limit should be carefully considered, to ensure fishing mortality does not increase to levels which would impede population recovery.

Allowable Harm

Given current information, existing activities (including bycatch in other fisheries) are not likely to cause further decline and jeopardize survival of the species at current levels. As such, allowable harm should not exceed current catch levels of existing activities that impact the species.

Data and Knowledge Gaps

Environmental changes and their impact on the interpretation of surveys (i.e. indices) require further consideration in the assessment of recovery potential for Roundnose Grenadier.

Sources of Uncertainty

- Surveys providing data for the assessment of recovery potential for Roundnose Grenadier do not cover the entire population range for this species in the Northwest Atlantic; only a subset of the population is sampled.
- Gear changes, and lack of conversion factors, limit comparisons between current and historic population levels of Roundnose Grenadier.
- Roundnose Grenadier is a benthopelagic species which undergoes diurnal/seasonal vertical migrations which can influence catchability. Therefore, catchability of this species is not consistent across all survey sets as it is greater at night.
- Misidentification of Grenadier to the species level can occur in commercial catch data that is used in the assessment of Roundnose Grenadier.

SOURCES OF INFORMATION

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FOR MORE INFORMATION

Contact: Don Power
Fisheries and Oceans Canada
PO Box 5667
St. John's NL
A1C 5X1
Tel: 709-772-4841
Fax: 709-772-4188
E-Mail: Don.Power@dfo-mpo.gc.ca

This report is available from the:

Centre for Science Advice (CSA)
Newfoundland and Labrador Region
Fisheries and Oceans Canada
PO Box 5667
St. John's, NL A1K 3E5
Telephone: (709) 772-3688
Fax: (709) 772-5315
E-Mail: nadine.templeman@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas

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